Proposed Title of the Thesis:

A study on metric and norm structures in multiset and other related hybrid settings

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SYNOPSIS

KEYWORDS: *Multi Numbers, Multi Metric, Multi Norm Multi Vector Space Multi Inner Product Spaces.*

1. Introduction:

Multiset (bag) is a well-established notion both in mathematics and in computer science. In mathematics, a multiset is considered to be the generalization of a set. In classical set theory, a set is a well-defined collection of distinct objects. If repeated occurrences of any object is allowed in a set, then a mathematical structure, that is known as multiset (mset, for short), is obtained. In various counting arguments it is convenient to distinguish between a set like {a; b; c} and a collection like {a; a; a; b; c; c}. The later, if viewed as a set, will be identical to the former. However, it has some of its elements purposely listed several times. We formalize it by defining a multiset as a collection of elements, each considered with certain multiplicity. For the sake of convenience a multiset is written as $\{k_1/x_1; k_2/x_2; \ldots; k_n/x_n\}$ in which the element x_i occurs k_i times. We observe that each multiplicity k_i is a positive integer.

Classical set theory states that a given element can appear only once in a set; it assumes that all mathematical objects occur without repetition. Thus there is only one number four, one field of complex numbers, etc. So, the only possible relation between two mathematical objects is either they are equal or they are different. However in the physical world it is observed that there is enormous repetition. For instance, there are many hydrogen atoms, many water molecules, many strands of DNA etc. Coins of the same denomination and year, electrons or grains of sand appear similar, despite being obviously separate. The concept of distance is very basic in Mathematics and it has wide applications in different fields.

2. Brief history of previous work done:

Wayne D. Blizard first studied multiset in 1989. From 1989 to 1991, he made a thorough study of multiset theory, real valued multisets and negative membership of the elements of multisets ([1], [2],[3],[4]). K. P. Girish and S. J. John introduced and studied the concepts of multiset topologies, multiset relations, multiset functions, chains and antichains of partially ordered multisets ([9], [10],[11],[12],[13]). D. Tokat studied the concept of soft multi continuous function [20]. Concepts of multi groups and soft multi groups are found in the studies of Sk. Nazmul and S. K. Samanta ([17], [18]). Many other authors like Chakrabarty et al. ([5], [6], [7], [8]), S. P. Jena et al. ([14]), J. L. Peterson ([19]) also studied various properties and applications of multisets.

In 2012, Girish and John [11] introduced multiset topologies induced by multiset relations. The same authors further studied the notions of open sets, closed sets, basis, sub basis, closure and interior, continuity and related properties in M-topological spaces in [12]. The concepts of semi open, semi closed multisets were introduced by J. Mahanta and D. Das in 2014 in [15], which were then used to study semi compactness in multiset topology. Further the concept of exterior and boundary in multiset topological space were given by the same authors in the year 2015 in [16].

3. Proposed plan of work to be done:

From the research articles surveyed above, it appears that there is a lot of scope of future works in the field of multi sets. More specifically I would like to study in the following directions:

- In multi set theory not much progress has been observed till now as it is a relatively new concept. Ideas like multi numbers, multi metric, multi norm and also other algebraic structures in multiset setting are yet to be studied.

But it is very essential to start with multi metric space and to study their properties.

- To study multi vector space.
- To study multi norm and multi inner product spaces and their properties.
- To study operator theory on multi norm and multi inner product spaces.
- To study the related hybrid structures.

4. Work already done:

We have already started in developing metric space in multiset settings. In this direction we have written a research paper entitled “On multi metric spaces” and communicated it to research journal for possible publication.

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